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ORIGINAL

FLOOD INSURANCE STUDY

COMPLETED
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TOWNSHIP OF BLOOMFIELD, MICHIGAN

OAKLAND COUNTY

JULY 6, 1982

Federal Emergency Management Agency

COMMUNITY NUMBER - 260169

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Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWNSHIP OF BLOOMFIELD,
OAKLAND COUNTY, MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Bloomfield, Oakland County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Township of Bloomfield to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by McNamee, Porter and Seeley/Smith, Hinchman and Grylls for the Federal Emergency Management Agency, under Contract No. H-4705. This study was completed in May 1981.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the Study Contractor, FEMA and the Township of Bloomfield in March 1978. Results of the hydrologic and hydraulic analyses were coordinated with the Michigan Department of Natural Resources, Water Management Division (DNR), which is the designated state-coordinating agency.

During the search for basic data, contacts were made with the Township of Bloomfield, the City of Bloomfield Hills, the Michigan DNR, the U.S. Army Corps of Engineers (COE), the U.S. Soil Conservation Service (SCS), the U.S. Geological Survey (USGS), the Michigan Department of Transportation, the Oakland County Drain Commission and Hubbell, Roth and Clark Associates, Inc.

On January 13, 1982, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Bloomfield, Oakland County, Michigan. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction for the next five years, through May 1986.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by FEMA and the Township of Bloomfield.

The limits of detailed and approximate studies in the Township of Bloomfield were determined by FEMA with community and Study Contractor consultation at the meeting in March 1978.

The flooding sources studied by detailed methods are listed below:

a. River Rouge, from Hunter Boulevard to 16 Mile Road, and from Grand Trunk Western Railroad to Adams Road, approximately 2.1 miles;

b. Franklin Branch River Rouge, within the corporate limits, approximately 1.3 miles;

c. Amy Drain, from the Bloomfield Hills corporate limits to about 1,600 feet upstream of Square Lake Road, approximately 0.9 mile;

d. Hamlin Drain, from the Bloomfield Hills corporate limits to about 600 feet north of Bloomfield Hills corporate limits, approximately 600 feet;

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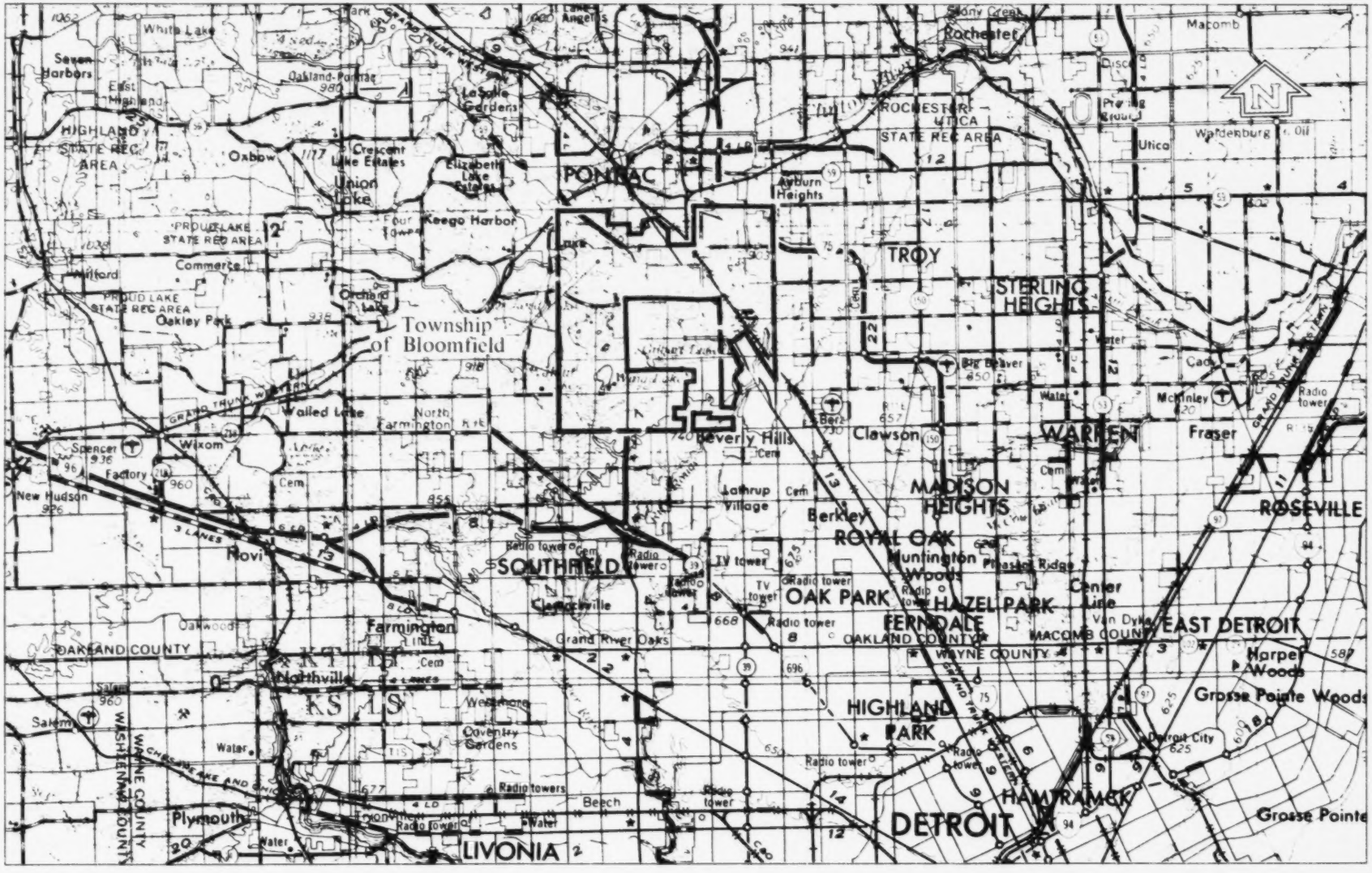
Township of Bloomfield
PONTIAC
TROY
STERLING HEIGHTS
WARREN
MADISON HEIGHTS
ROSEVILLE
ROYAL OAK
SOUTHFIELD
OAK PARK
HAZEL PARK
FERNDALE
EAST DETROIT
HIGHLAND PARK
HAMTRAMCK
DETROIT
LIVONIA
Farmington
Northville
Plymouth
Novi
Wixom
Walled Lake
Commerce
Milford
Oakley Park
Keego Harbor
Union Lake
White Lake
Oxbow
Rochester
Utica
Macomb
Berkley
Beverly Hills
Clawson
Fraser
Grosse Pointe Woods
Grosse Pointe
Harper Woods
Center Line
Madison Heights
Huntington Woods
Pleasant Ridge
Van Dyke
Detroit City
Grand River Oaks
Coventry Gardens
Westshore
Lathrup Village
North Farmington
Auburn Heights
Orchard Lake
Crescent Lake Estates
Elizabeth Lake Estates
LaSalle Gardens
Oakland-Pontiac
Seven Harbors
East Highland
HIGHLAND STATE REC AREA
PROUD LAKE STATE REC AREA
ROCHESTER-UTICA STATE REC AREA
OAKLAND COUNTY
WAYNE COUNTY
MACOMB COUNTY
WASHTENAW COUNTY
CHESAPEAKE AND OHIO
GRAND TRUNK W
GRAND TRUNK
Waterford
Big Beaver
McKinley
Cadillac
Radio tower
TV tower
Water
Cem
Beech
Spencer
Factory
New Hudson
Salem
Oakwood
Clarenceville
Waldenburg
Oil
Macomb
Stony Creek
Lake Angelus
Pontiac Lake
Utica
Fraser
Roseville
Grosse Pointe
Harper Woods
Grosse Pointe Woods
Detroit City
Center Line
Van Dyke
Pleasant Ridge
Huntington Woods
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Lathrup Village
Berkley
Beverly Hills
Clawson
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Coventry Gardens
Westshore
Lathrup Village
North Farmington
Auburn Heights
Orchard Lake

e. Murphy Drain, from Bloomfield Hills corporate limits to Wilshire Drive, approximately 1.0 mile;

f. Sodon Lake Drain, from the western corporate limits of Bloomfield Hills to about 100 feet upstream of Telegraph Road, approximately 1.2 miles; and

g. Long Lake-Forest Lake Drain, from the western corporate limits of Bloomfield Hills to Club Drive, approximately 2.7 miles.

Streams and lakes studied by approximate methods include Lower Long Lake, Forest Lake, Island Lake, Wood Lake, Crest Lake and portions of the Sprague Branch River Rouge, Meadow Lake Drain, Sodon Lake Drain, Murphy Drain, Tributary A and Tributary B.

Upper Long Lake, although originally studied by approximate methods, has been shown in this study with detailed flooding, since detailed information was made available by the West Bloomfield Township Flood Insurance Study (Reference 1).

2.2 Community Description

The Township of Bloomfield is located in southeast Oakland County in southeast Michigan. The total land area contained within the township corporate limits is approximately 26.5 square miles. It is situated approximately 10 miles north of the City of Detroit. The Township of Bloomfield is bordered by the City of Pontiac and the Township of Pontiac on the north, the cities of Troy and Birmingham on the east, the Cities of Beverly Hills, Bingham Farms and the Village of Franklin on the south, and the Township of West Bloomfield and the City of Sylvan Lake on the west. The City of Bloomfield Hills is surrounded by the township and the City of Birmingham on the south. According to the U.S. Census Bureau, the population has stabilized, with a slight increase from 42,788 in 1970 to 42,876 in 1980 (Reference 2).

Based on the U.S. Weather Bureau Station in Mount Clemens, 18 miles east of the Township of Bloomfield, the highest temperature ever recorded was 106 degrees Fahrenheit (F.) and the lowest was -24 degrees F. The average highest monthly temperature, 78.7 degrees F., was recorded in July 1955, and the lowest monthly temperature, 13.5 degrees F., was recorded in January 1912. Average annual precipitation is about 27.5 inches. The greatest amount of precipitation received during a one-month period was 8.15 inches in June 1940. The smallest amount during a one-month period was 0.06 inch in December 1900. The average annual snowfall is 31.3 inches, but the amount varies considerably from one year to another. Extremes in the past 30 years vary from a maximum of 49.9 inches in the 1951-52 season to as little as 12.4 inches in the 1952-53 season (Reference 3).

The topography of the Township of Bloomfield is gently rolling with the highest elevation being approximately 950 feet National Geodetic Vertical Datum in the northwestern part of the township to the lowest elevation of approximately 760 feet in the southeast part of the township.

The soils in the Township of Bloomfield are predominantly of the Urban land-Marlette complex and Urban land-Spinks complex (Reference 4). These soils are predominantly well drained with some poorly drained areas.

The township is primarily a residential community with some commercial development and light industry. Development within the flood plain is predominantly residential.

2.3 Principal Flood Problems

The history of flooding on the streams within the Township of Bloomfield has shown flooding of residential structures. Although no high water marks are available, flash floods of large magnitude have occurred in 1956, 1965, 1968, 1969 and 1975 on the River Rouge.

2.4 Flood Protection Measures

Nonstructural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Code of Federal Regulations which control building within areas that have a high risk of flooding (Reference 5).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 per cent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one per cent chance of annual occurrence) in any 50-year period is about 40 per cent (four in ten), and for any 90-year period, the risk increases to about 60 per cent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Flood flow frequency data for all streams studied by detailed methods was based on an analysis utilizing Brater's Unit Hydrograph Method (Reference 6). This method considers factors such as population density, infiltration capacity and rainfall intensity-duration patterns.

HEC-1 routing was required on the Sodon Lake Drain, Long Lake-Forest Lake Drain, Hamlin Drain, the River Rouge and Amy Drain. HEC-1 relates the basin characteristics and rainfall data to stream discharge (Reference 7).

The discharge data for the River Rouge between Hunter Boulevard and 16 Mile Road was taken from the Birmingham Flood Insurance Study (Reference 8). The decrease in the 10-year storm discharge that occurs below the Grand Trunk Western Railroad can be attributed to storage of floodwaters behind the railroad embankments.

A decrease in discharge occurs on Amy Drain and is attributed to storage upstream in Vhay Lake and a backup at the Grand Trunk Western Railroad. On Hamlin Drain, downstream of the confluence of Stoneycraft Drain, the ma.n flow from Stoneycraft Drain goes to Amy Drain, causing a decrease in discharges on Hamlin Drain.

Flood elevations for Walnut Lake, Hammond Lake, and Upper Long Lake were taken from the preparation of work for the Township of West Bloomfield, Michigan Flood Insurance Study (Reference 1).

TABLE 1 - SUMMARY OF ELEVATIONS[1]

LOCATION	ELEVATIONS (NGVD) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WALNUT LAKE	882.2	882.9	883.1	883.7
HAMMOND LAKE	920.6	920.8	921.0	921.3
UPPER LONG LAKE	913.4	913.7	913.8	914.0

[1]Elevations taken from Township of West Bloomfield, Michigan Flood Insurance Study (Reference 1).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 2.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

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TABLE 2 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA SQ MILES	PEAK DISCHARGES (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
RIVER ROUGE					
Just upstream Quarton Branch	14.8	1,110	1,700	1,980	2,650
Just upstream Grand Trunk Western Railroad	13.3	1,180	1,630	1,830	2,270
FRANKLIN BRANCH RIVER ROUGE					
13 Mile Road	15.4	965	1,410	1,640	2,220
Upstream of Franklin Road	13.6	870	1,280	1,490	2,030
AMY DRAIN					
Just downstream Kingsley Trail (Confluence with Hamlin Drain Overflow)	1.6	185	280	320	420
Just downstream Great Oaks Drive	1.3	125	180	220	290
At Square Lake Road	1.1	45	70	80	90
HAMLIN DRAIN					
Just upstream of Kensington Road	1.2	249	360	430	600
MURPHY DRAIN					
Just upstream of Woodward Avenue	1.5	300	445	525	730
At Wendover Road	1.3	220	340	400	570
SODON LAKE DRAIN					
At downstream corporate limits	1.4	120	170	190	270
At Stoneleigh Drive	1.3	90	129	140	190
Just downstream Lakes	1.2	35	40	45	50
LONG LAKE-FOREST LAKE DRAIN					
At Lahser Road	5.9	190	245	270	330
At West Long Lake Road	5.6	155	180	195	230
At Orange Lake Outlet	5.3	75	110	130	185
At Franklin Road	4.6	20	35	60	95

Cross sections for the backwater analyses of the River Rouge, Franklin Branch-River Rouge, Amy Drain, Hamlin Drain, Murphy Drain, Sodon Lake Drain and Long Lake-Forest Lake Drain were obtained photogrammetrically from aerial photographs flown in November 1978 at a negative scale of 1:9600 (Reference 9). The below-water sections were obtained by field measurement. All bridges, dams and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map.

Channel roughness factors (Manning's "n") used in the hydraulic computations were based on field observations of the streams and flood plain areas. Roughness values for the main channels range from 0.030 to 0.075 with flood plain roughness values ranging from 0.030 to 0.15 for all floods.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the HEC-2 step-backwater computer program (References 10, 11 and 12). Starting water-surface elevations for all streams studied by detailed methods were calculated using the slope-area method.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using the topographic map at a scale of 1:4800 with a contour interval of two feet (Reference 9).

For the streams studied by approximate methods, the boundary of the 100-year flood was developed using water-surface elevations from detailed study limits and contiguous studies and delineating the boundaries on a topographic map with a scale of 1:4800 and contour interval of two feet (Reference 9).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of FEMA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Michigan, though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 13), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Bureau of Water Management, a floodway having no more than a 0.1-foot surcharge has been delineated for this study.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2). Portions of the floodway for the Franklin Branch River Rouge and the River Rouge lie outside of the corporate limits.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
RIVER ROUGE							
A	160	50	758	2.6	747.6	747.6	0.0
B	2290	333	3444	0.6	748.0	748.0	0.0
C	2990	80	1038	1.9	748.0	748.0	0.0
D	3290	180	1111	1.8	748.2	748.2	0.0
E	4390	170	2252	0.9	748.8	748.8	0.0
F	6225	267	1625	1.1	757.0	757.0	0.0
G	6310	325	3256	0.6	757.3	757.3	0.0
H	7215	150	1111	1.6	757.4	757.4	0.0
I	8900	332	1973	0.9	758.0	758.0	0.0
J	10,570	181	875	2.1	758.9	758.8	0.1
K	11,925	167	697	2.6	761.8	761.7	0.1
L	12,750	250	709	2.6	764.0	763.9	0.1
FRANKLIN BRANCH RIVER ROUGE							
A	110	130	581	2.8	763.1	763.0	0.1
B	300	100	297	5.5	767.3	767.2	0.1
C	400	170	832	1.8	767.3	767.2	0.1
D	450	210	1419	1.1	767.4	767.3	0.1
E	1260	191	650	2.3	768.0	767.9	0.1
F	1900	84	325	4.6	770.9	770.8	0.1
G	2825	50	257	5.8	777.7	777.6	0.1
H	5275	210	826	1.8	788.0	787.9	0.1

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

RIVER ROUGE - FRANKLIN BRANCH RIVER ROUGE

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
AMY DRAIN							
A	60	280	819	0.4	847.1	847.1	0.0
B	475	370	1018	0.3	848.6	848.6	0.0
C	1070	100	187	1.7	849.4	849.4	0.0
D	1550	33	82	3.9	850.7	850.7	0.0
E	1680	7	29	7.7	853.2	853.2	0.0
F	1800	73	116	1.9	853.6	853.6	0.0
G	2135	50	98	2.2	854.5	854.5	0.0
H	2275	140	92	2.4	855.1	855.1	0.0
I	2350	77	123	1.8	855.2	855.2	0.0
J	3125	47	120	1.8	855.7	855.7	0.0
K	3275	5	39	2.1	860.0	860.0	0.0
L	3370	137	774	0.1	860.1	860.1	0.0
M	4100	472	2216	0.0	860.1	860.1	0.0
N	4900	534	2412	0.0	860.1	860.1	0.0
HAMLIN DRAIN							
A	540	18	47	9.1	870.5	870.5	0.0
B	595	29	95	4.5	872.2	872.2	0.0

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

AMY DRAIN - HAMLIN DRAIN

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
MURPHY DRAIN							
A	30	150	251	2.1	885.7	885.7	0.0
B	210	80	198	2.6	886.4	886.3	0.1
C	300	80	251	2.1	887.5	887.4	0.1
D	425	65	194	2.7	887.8	887.7	0.1
E	450	69	135	3.9	887.8	887.7	0.1
F	780	90	272	1.9	891.5	891.5	0.0
G	975	121	315	1.7	893.3	893.3	0.0
H	1025	53	76	6.9	893.5	893.5	0.0
I	1080	66	162	3.2	894.7	894.7	0.0
J	1475	80	385	1.4	902.2	902.2	0.0
K	1650	79	222	2.4	902.3	902.3	0.0
L	1865	200	993	0.5	905.7	905.7	0.0
M	2025	241	876	0.6	905.7	905.7	0.0
N	2090	170	248	2.1	906.0	906.0	0.0
O	2410	110	309	1.7	907.2	907.1	0.1
P	3550	90	126	4.2	912.0	911.9	0.1
Q	4575	110	313	1.7	918.1	918.1	0.0
R	5400	35	96	5.5	922.1	922.0	0.1

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

MURPHY DRAIN

BEST DOCUMENT AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
SODON LAKE DRAIN							
A	30	135	826	0.2	831.6	831.5	0.1
B	380	150	710	0.3	831.6	831.5	0.1
C	700	324	1658	0.1	831.6	831.5	0.1
D	1500	120	127	0.8	831.7	831.6	0.1
E	1625	130	86	1.2	832.1	832.1	0.0
F	1675	100	74	1.3	832.8	832.8	0.0
G	2000	80	74	1.3	835.5	835.5	0.0
H	2530	111	60	1.7	838.9	838.9	0.0
I	3210	55	80	1.3	846.3	846.2	0.1
J	3610	70	351	0.1	847.6	847.5	0.1
K	3800	10	17	2.7	848.7	848.6	0.1
L	3870	74	113	0.4	848.8	848.7	0.1
M	4350	197	348	0.1	848.8	848.7	0.1
N	4950	13	11	4.2	848.8	848.7	0.1
O	5000	14	14	3.3	850.1	850.1	0.0
P	5150	9	24	1.9	851.4	851.4	0.0
Q	5240	27	18	2.6	854.6	854.6	0.0
R	5340	28	88	0.5	854.7	854.7	0.0
S	5610	11	17	2.7	855.0	855.0	0.0
T	5790	15	20	2.2	855.5	855.5	0.0

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

SODON LAKE DRAIN

BEST DOCUMENT AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
LONG LAKE–FOREST LAKE DRAIN							
A	30	250	342	0.8	858.5	858.4	0.1
B	425	95	157	1.7	862.2	862.1	0.1
C	475	81	167	1.6	862.3	862.2	0.1
D	630	13	26	10.5	865.8	865.8	0.0
E	775	116	136	2.0	867.8	867.7	0.1
F	1040	71	128	2.1	869.4	869.3	0.1
G	1070	70	337	0.8	871.3	871.2	0.1
H	1175	90	171	1.6	871.4	871.3	0.1
I	1575	65	171	1.6	872.9	872.8	0.1
J	1675	60	171	1.6	873.1	873.0	0.1
K	1775	50	69	3.9	873.6	873.6	0.0
L	1875	12	122	2.2	882.2	882.1	0.1
M	1960	71	435	0.6	882.3	882.2	0.1
N	2140	12	164	1.2	889.7	889.6	0.1
O	2240	249	2384	0.1	889.7	889.6	0.1
P	2750	98	716	0.3	889.7	889.6	0.1
Q	2775	106	515	0.4	889.7	889.6	0.1
R	3200	116	863	0.2	889.7	889.6	0.1
S	3500	143	638	0.3	889.7	889.6	0.1
T	3555	56	281	0.7	889.7	889.6	0.1
U	3675	14	64	3.0	890.8	890.7	0.1
V	3760	68	336	0.6	891.0	890.9	0.1
W	4780	31	46	4.2	894.3	894.3	0.0
X	5690	240	342	0.6	896.9	896.8	0.1
Y	6000	160	108	1.2	899.2	899.1	0.1
Z	6075	170	41	3.2	900.7	900.6	0.1

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

LONG LAKE-FOREST LAKE DRAIN

BEST DOCUMENT AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
LONG LAKE–FOREST LAKE DRAIN							
AA	6600	28	54	2.4	901.7	901.6	0.1
AB	6825	18	88	1.5	905.6	905.5	0.1
AC	7275	90	391	0.3	905.6	905.5	0.1
AD	7525	50	94	1.4	905.7	905.6	0.1
AE	8050	17	34	3.8	906.7	906.7	0.0
AF	8390	43	97	1.3	907.3	907.3	0.0
AG	9075	41	86	1.5	907.8	907.7	0.1
AH	9775	70	156	0.8	908.3	908.2	0.1
AI	10,030	24	86	0.7	909.8	909.7	0 1
AJ	10,210	75	90	0.6	909.8	909.7	0.1
AK	10,750	277	931	0.1	909.8	909.7	0.1
AL	11,575	110	277	0.2	909.8	909.7	0.1
AM	11,890	120	277	0.2	909.8	909.7	0.1
AN	11,955	116	261	0.2	909.8	909.7	0.1
AO	12,090	100	226	0.3	909.8	909.7	0.1
AP	12,370	48	111	0.5	909.8	909.7	0.1
AQ	12,480	55	143	0.4	909.8	909.7	0.1
AR	12,525	62	143	0.4	909.8	909.7	0.1
AS	13,060	300	739	0.1	910.0	909.9	0.1
AT	13,115	309	739	0.1	910.0	909.9	0.1
AU	13,410	150	375	0.3	911.0	910.9	0.1
AV	14,000	110	150	0.4	911.1	911.0	0.1

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOODWAY DATA

LONG LAKE-FOREST LAKE DRAIN

BEST DOCUMENT AVAILABLE

As shown on the Flood Boundary and Floodway Map, the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

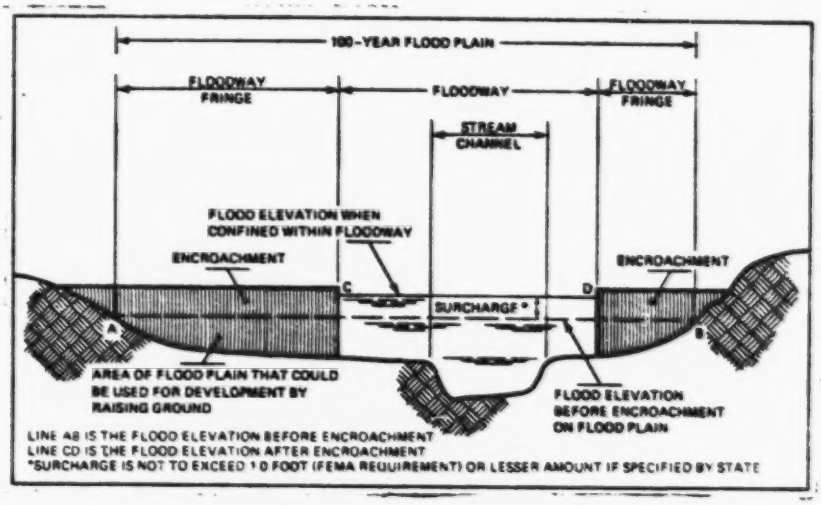
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, FEMA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Township of Bloomfield.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 per cent of the reach.

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Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Township of Bloomfield are shown on the Flood Profiles and are summarized in Table 3, "Flood Insurance Zone Data."

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Bloomfield was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.

Zones A1-A3, A5-A7, A12, A14: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding

where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Bloomfield is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by FEMA.

6.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the City of Pontiac (Reference 14); the Township of Pontiac (Reference 15); the City of Troy (Reference 16); the City of Birmingham (Reference 8); the Village of Franklin (Reference 17); and the Township of West Bloomfield (Reference 1). These studies agree exactly with the Township of Bloomfield study.

A Flood Hazard Boundary Map has been published for the community (Reference 18). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 300 South Wacker Drive, (24th Floor), Chicago, Illinois 60606.

BEST DOCUMENT AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
RIVER ROUGE							
REACH 1	0016	–7.1	–2.6	7.0	070	A14	VARIES–SEE MAP
REACH 2	0016	–3.4	–1.9	6.8	035	A7	VARIES–SEE MAP
REACH 3	0016	–3.2	–1.5	7.8	030	A6	VARIES–SEE MAP
REACH 4	0016	–1.5	–0.6	5.3	015	A3	VARIES–SEE MAP
FRANKLIN BRANCH RIVER ROUGE							
REACH 1	0013	–0.8	–0.2	0.6	010	A2	VARIES–SEE MAP
REACH 2	0013	–2.5	–0.7	0.9	025	A5	VARIES–SEE MAP
REACH 3	0013	–1.1	–0.4	0.7	010	A2	VARIES–SEE MAP
AMY DRAIN							
REACH 1	0004	–0.8	–0.3	2.4	010	A2	VARIES–SEE MAP
REACH 2	0004,0005	–3.7	–1.3	0.4	035	A7	VARIES–SEE MAP
HAMLIN DRAIN							
REACH 1	0004	–1.1	–0.6	0.8	010	A2	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

RIVER ROUGE
FRANKLIN BRANCH RIVER ROUGE - AMY DRAIN - HAMLIN DRAIN

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
MURPHY DRAIN							
REACH 1	0003,0004	–0.6	–0.2	0.4	005	A1	VARIES–SEE MAP
SODON LAKE DRAIN							
REACH 1	0004,0012,0015	–0.4	–0.2	0.2	005	A1	VARIES–SEE MAP
LONG LAKE–FOREST LAKE DRAIN							
REACH 1	0004	–0.6	–0.2	0.2	005	A1	VARIES–SEE MAP
REACH 2	0004	–3.6	–1.5	1.4	035	A7	VARIES–SEE MAP
REACH 3	0004	–6.1	–2.5	4.3	060	A12	VARIES–SEE MAP
REACH 4	0004	–2.9	–2.2	4.3	030	A6	VARIES–SEE MAP
REACH 5	0003,0004	–1.2	–0.6	1.6	010	A2	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

MURPHY DRAIN - SODON LAKE DRAIN - LONG LAKE-FOREST LAKE DRAIN

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BEST DOCUMENT AVAILABLE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
WALNUT LAKE							
REACH 1[4]	0015	–0.9	–0.2	0.6	010	A2	883
HAMMOND LAKE							
REACH 1[4]	0005	–0.4	–0.1	0.3	005	A1	921
UPPER LONG LAKE							
REACH 1[4]	0003	–0.5	–0.1	0.2	005	A1	914

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT
[4]DATA FOR THIS REACH TAKEN FROM TOWNSHIP OF WEST BLOOMFIELD, MICHIGAN FIS

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

FLOOD INSURANCE ZONE DATA

WALNUT LAKE - HAMMOND LAKE - UPPER LONG LAKE

8.0 REFERENCES AND BIBLIOGRAPHY

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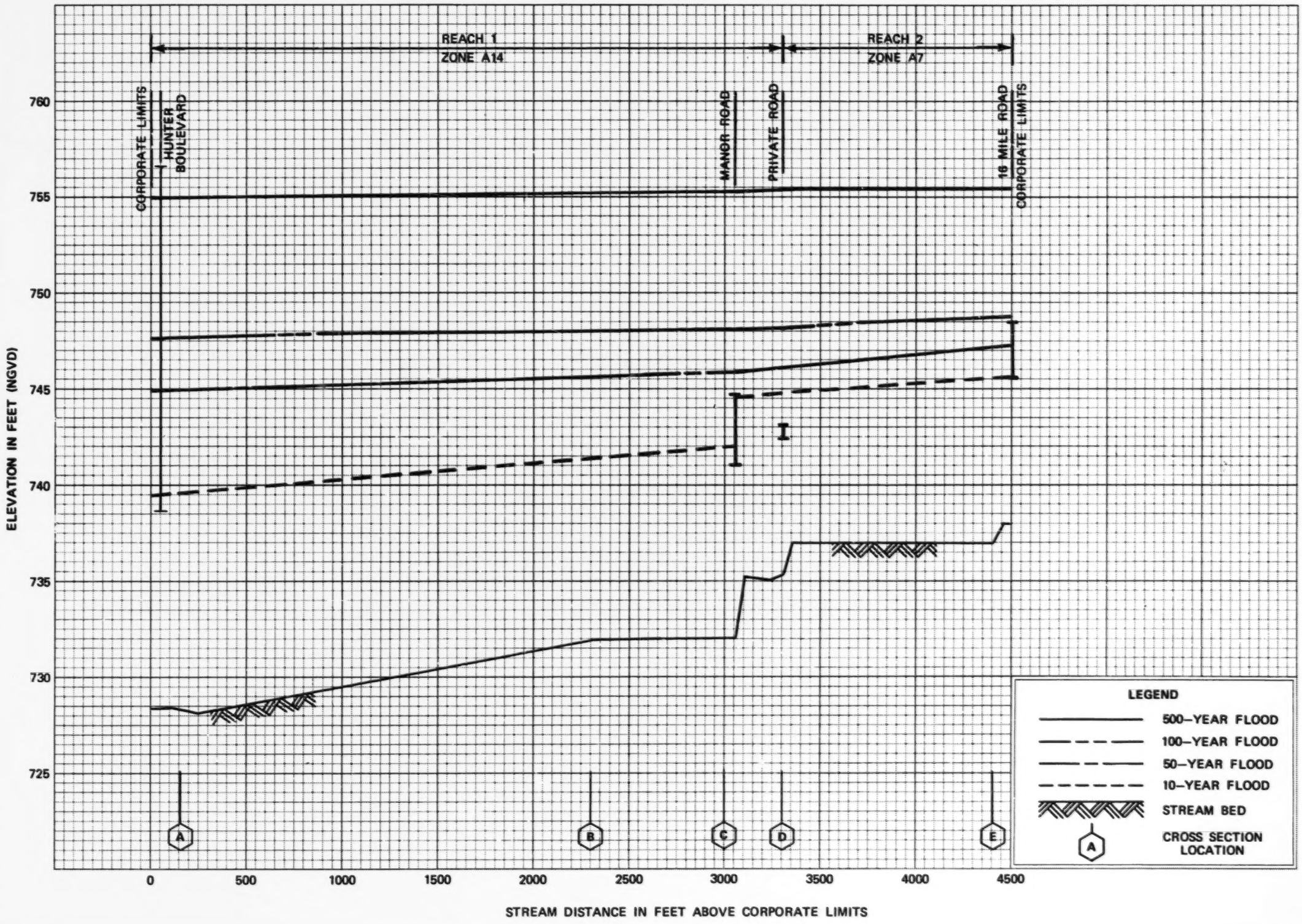

FLOOD PROFILES

RIVER ROUGE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

01P

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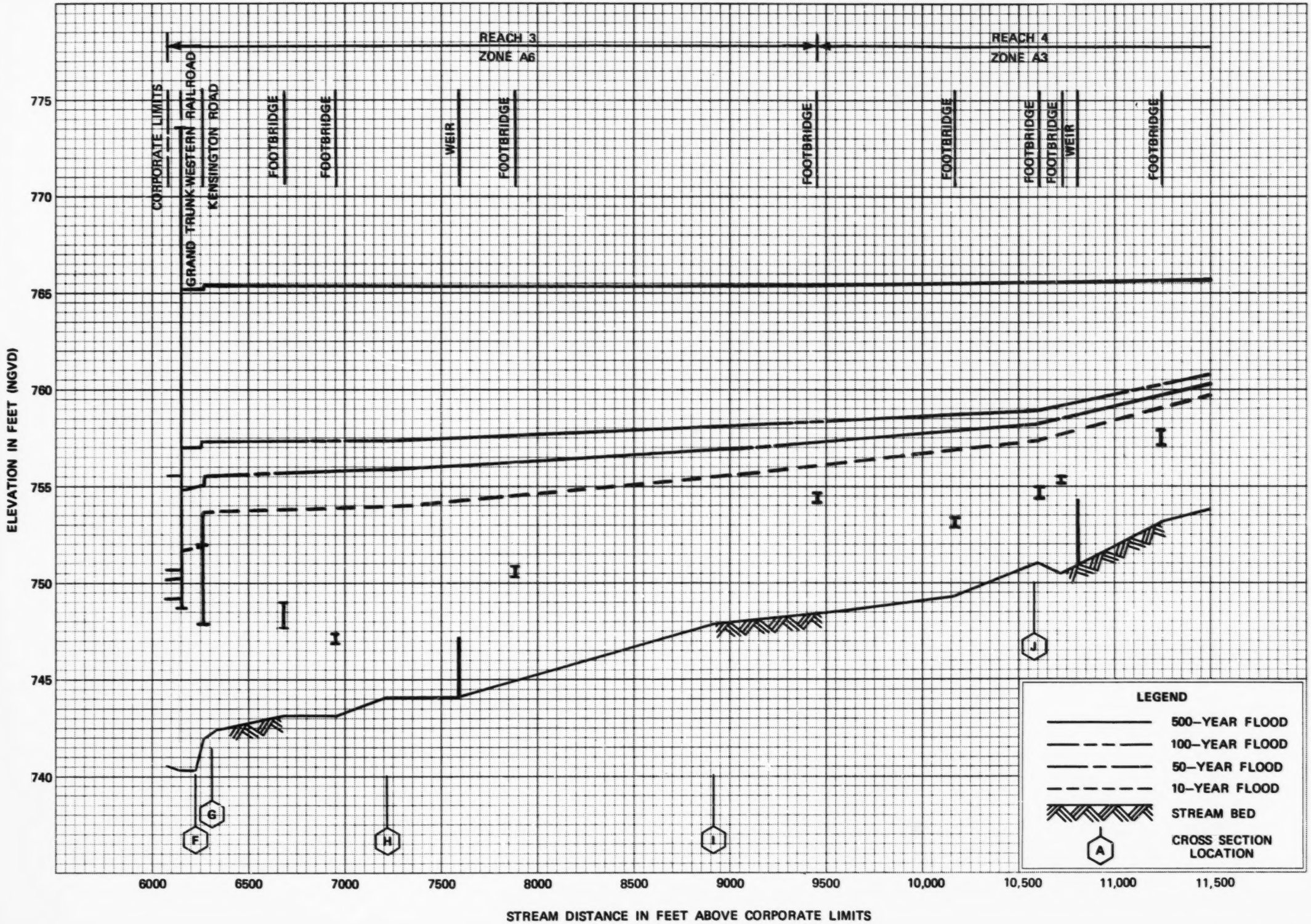

FLOOD PROFILES

RIVER ROUGE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

02P

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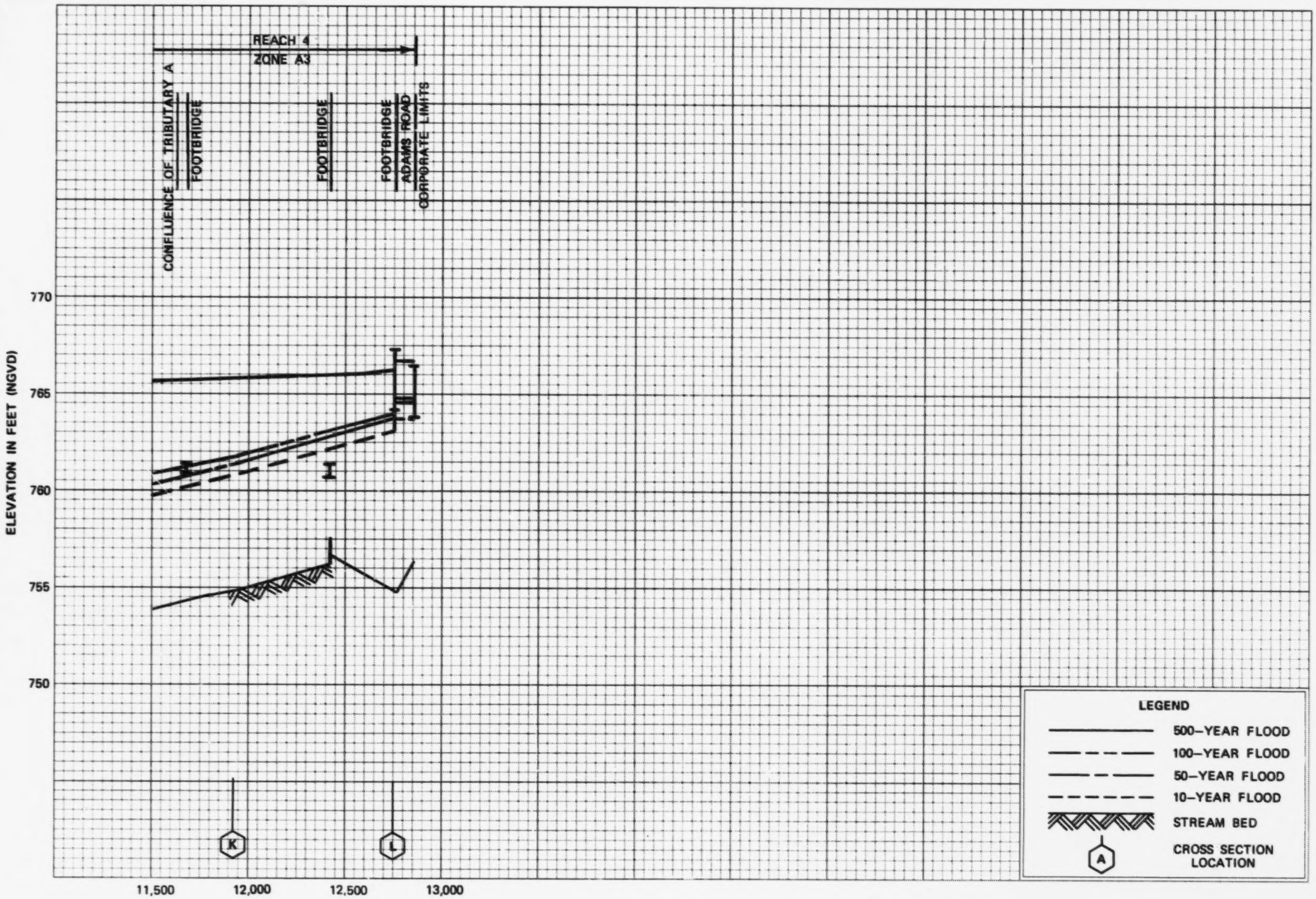

FLOOD PROFILES

RIVER ROUGE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

03P

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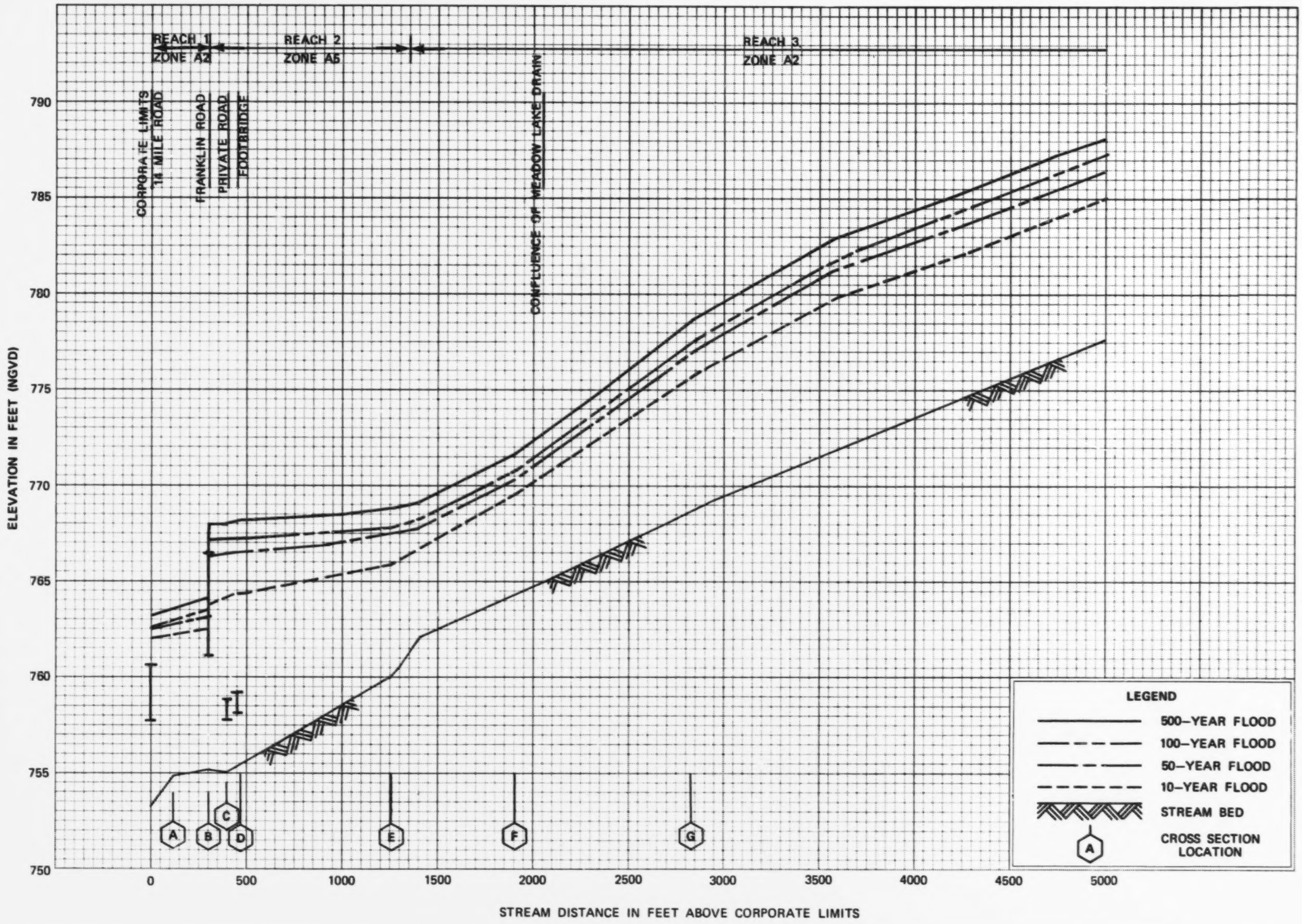

FLOOD PROFILES

FRANKLIN BRANCH RIVER ROUGE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

04P

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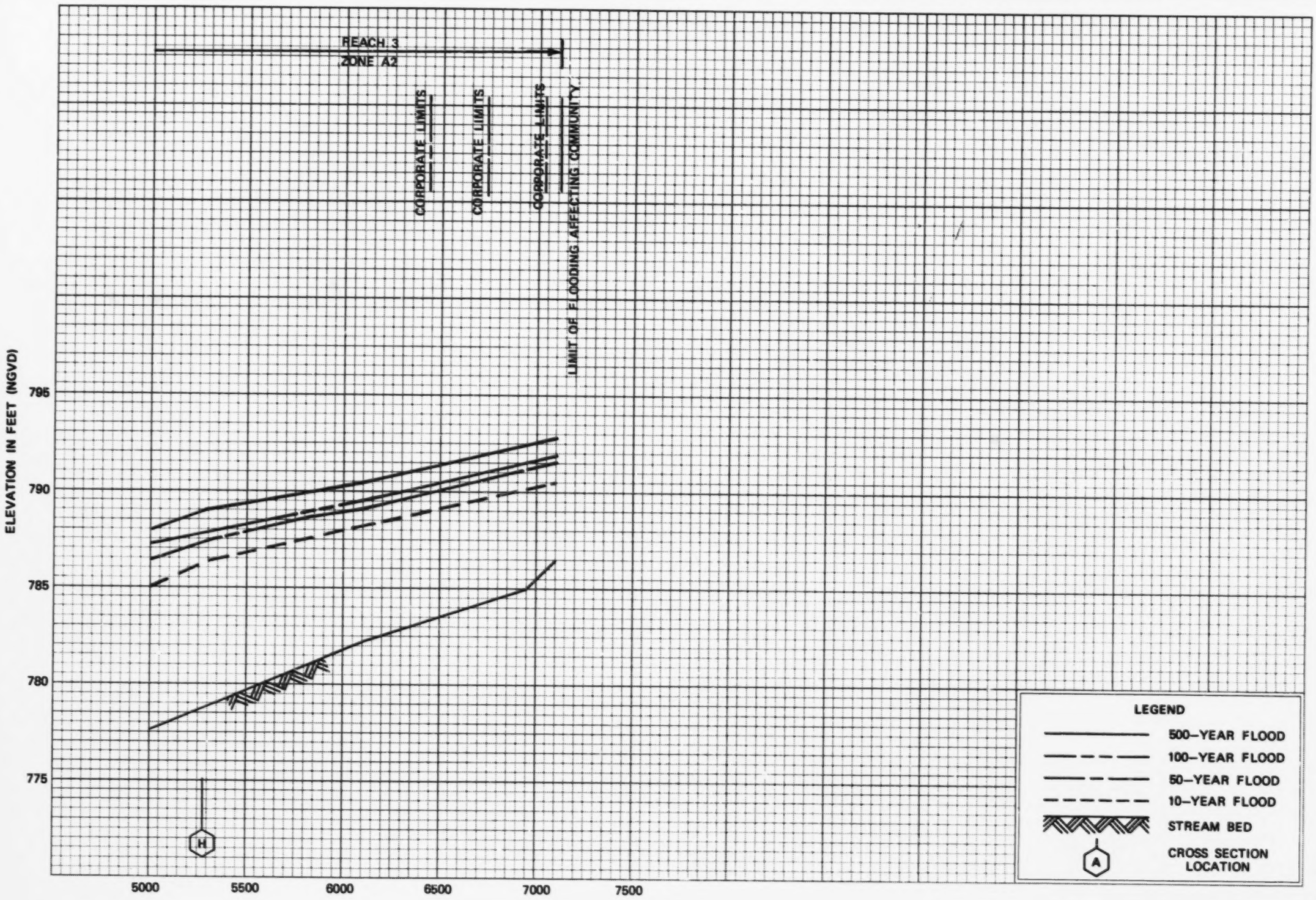

FLOOD PROFILES

FRANKLIN BRANCH RIVER ROUGE

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

05P

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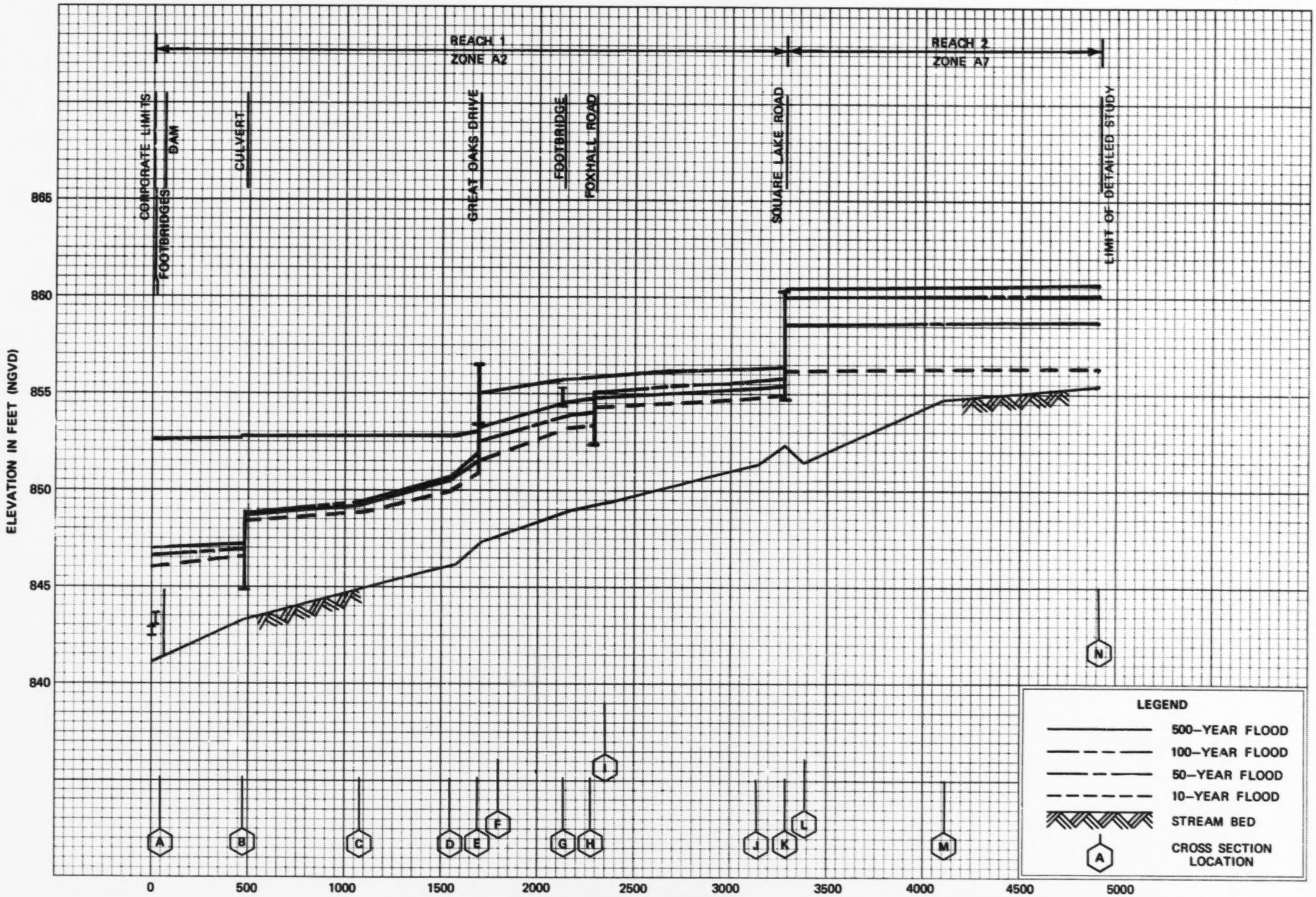

FLOOD PROFILES

AMY DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

06P

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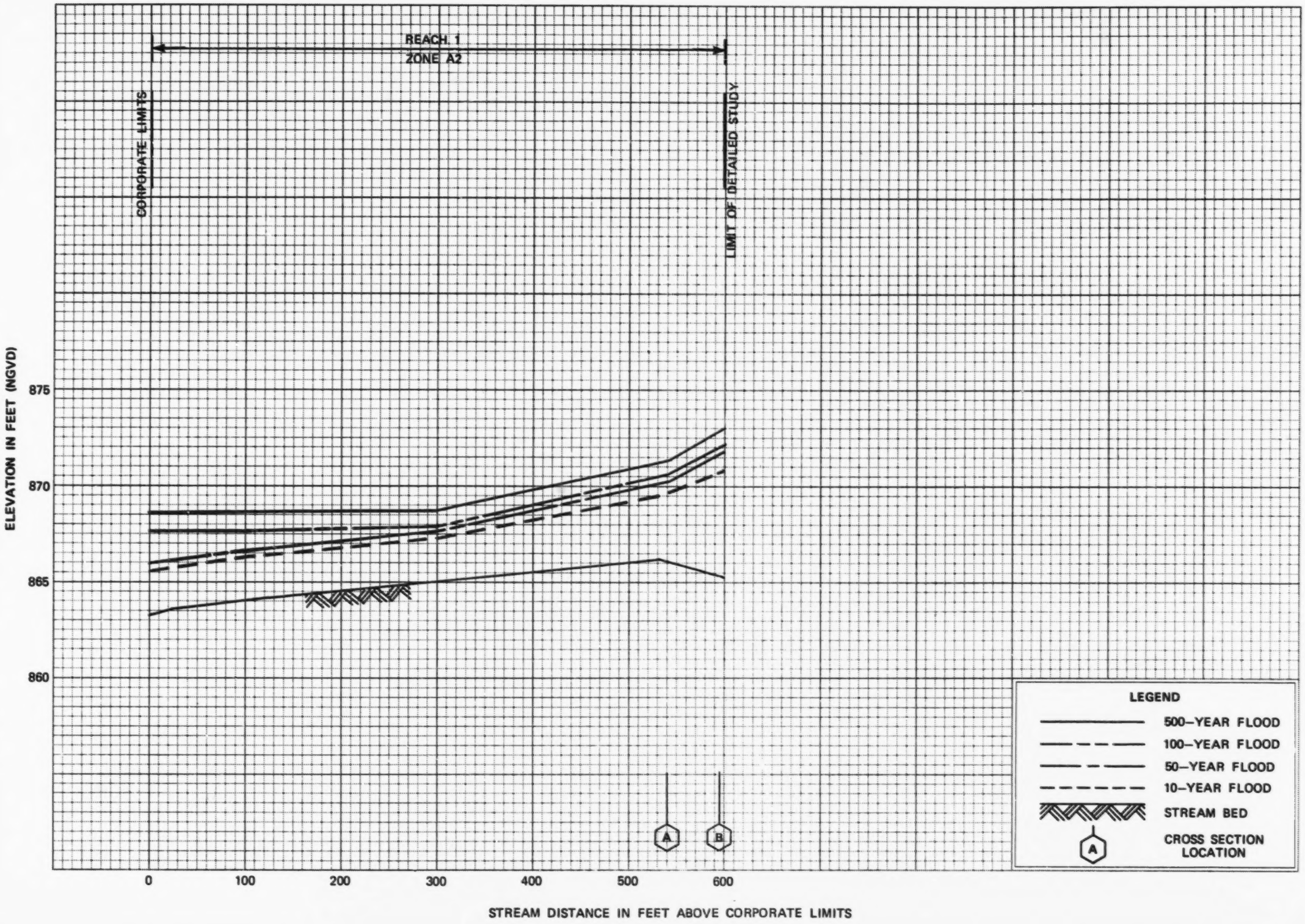

FLOOD PROFILES

HAMLIN DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

07P

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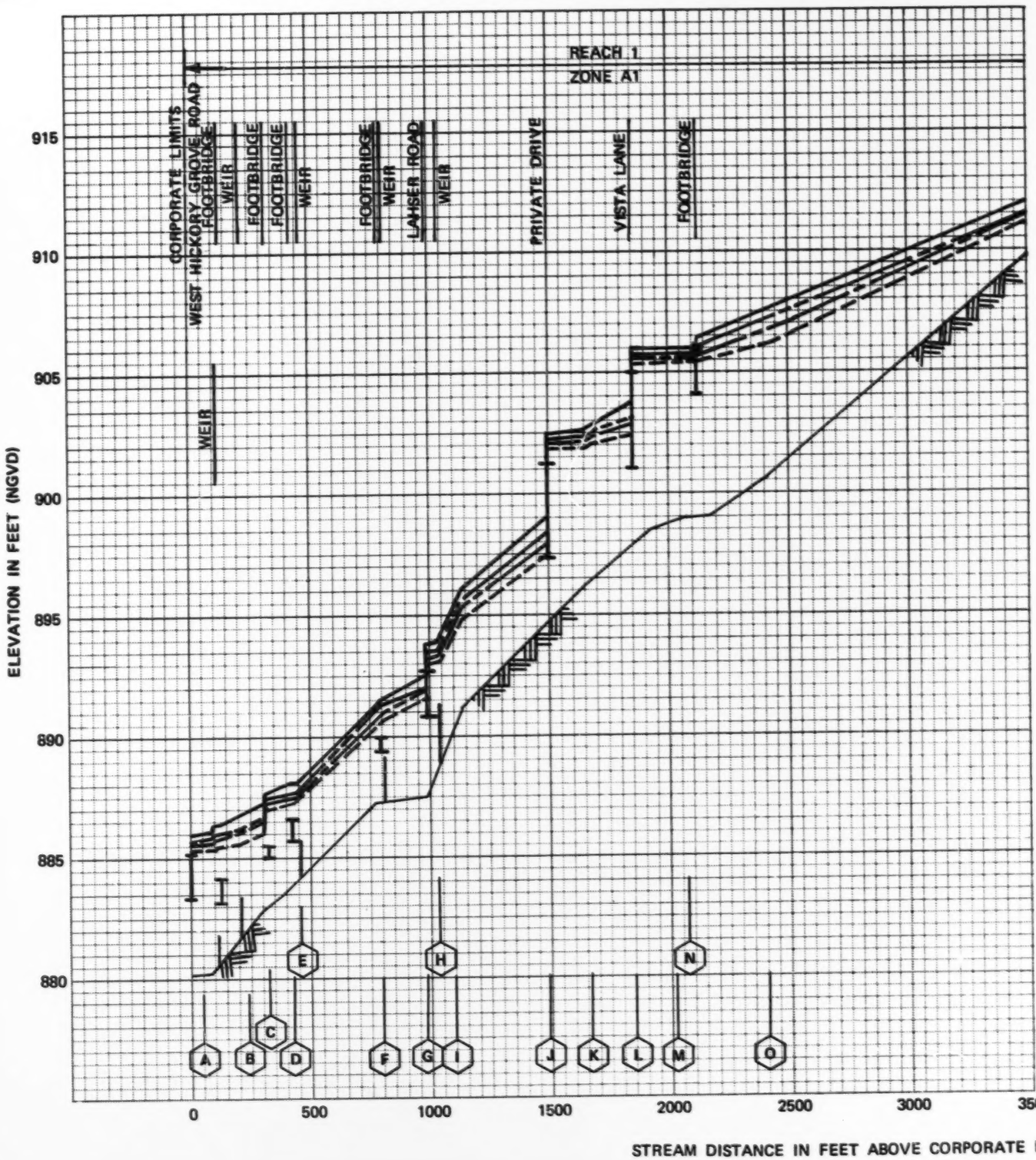

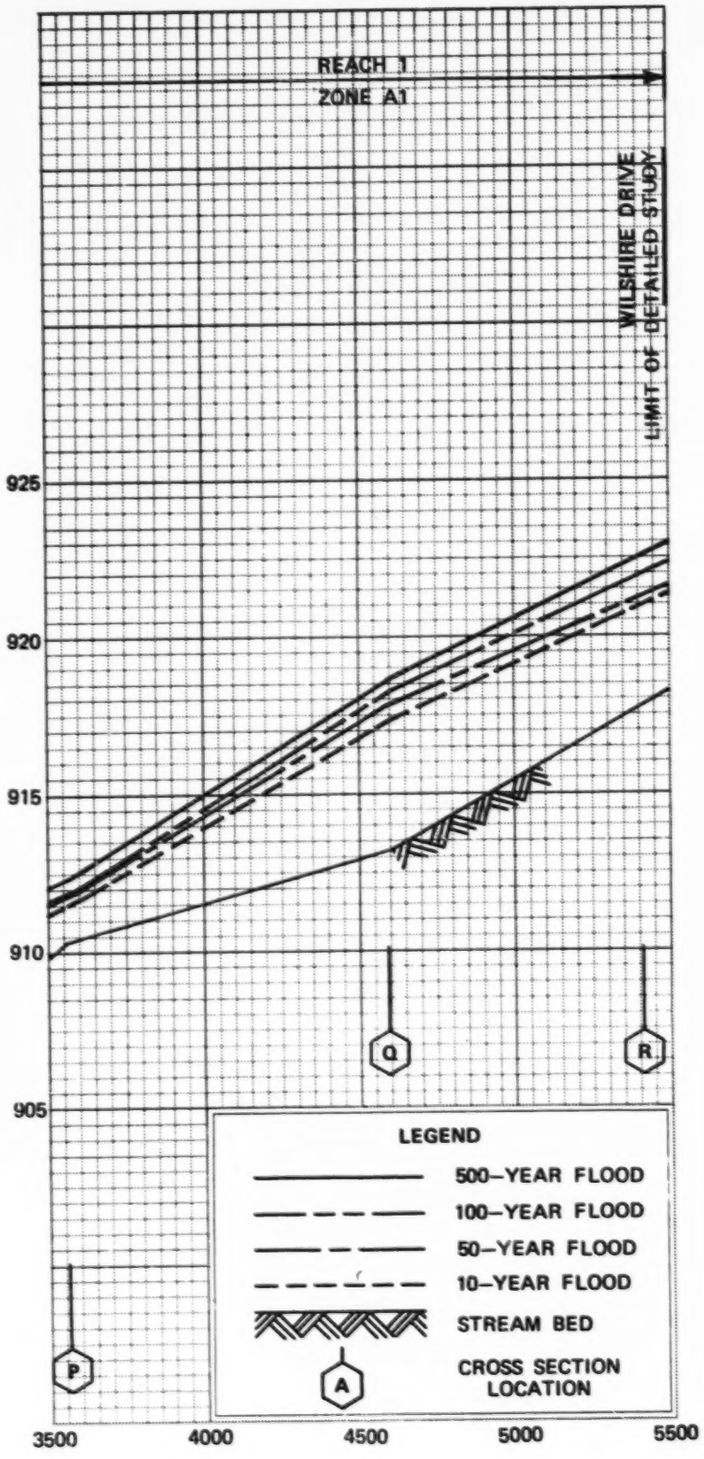

FLOOD PROFILES

MURPHY DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

08P

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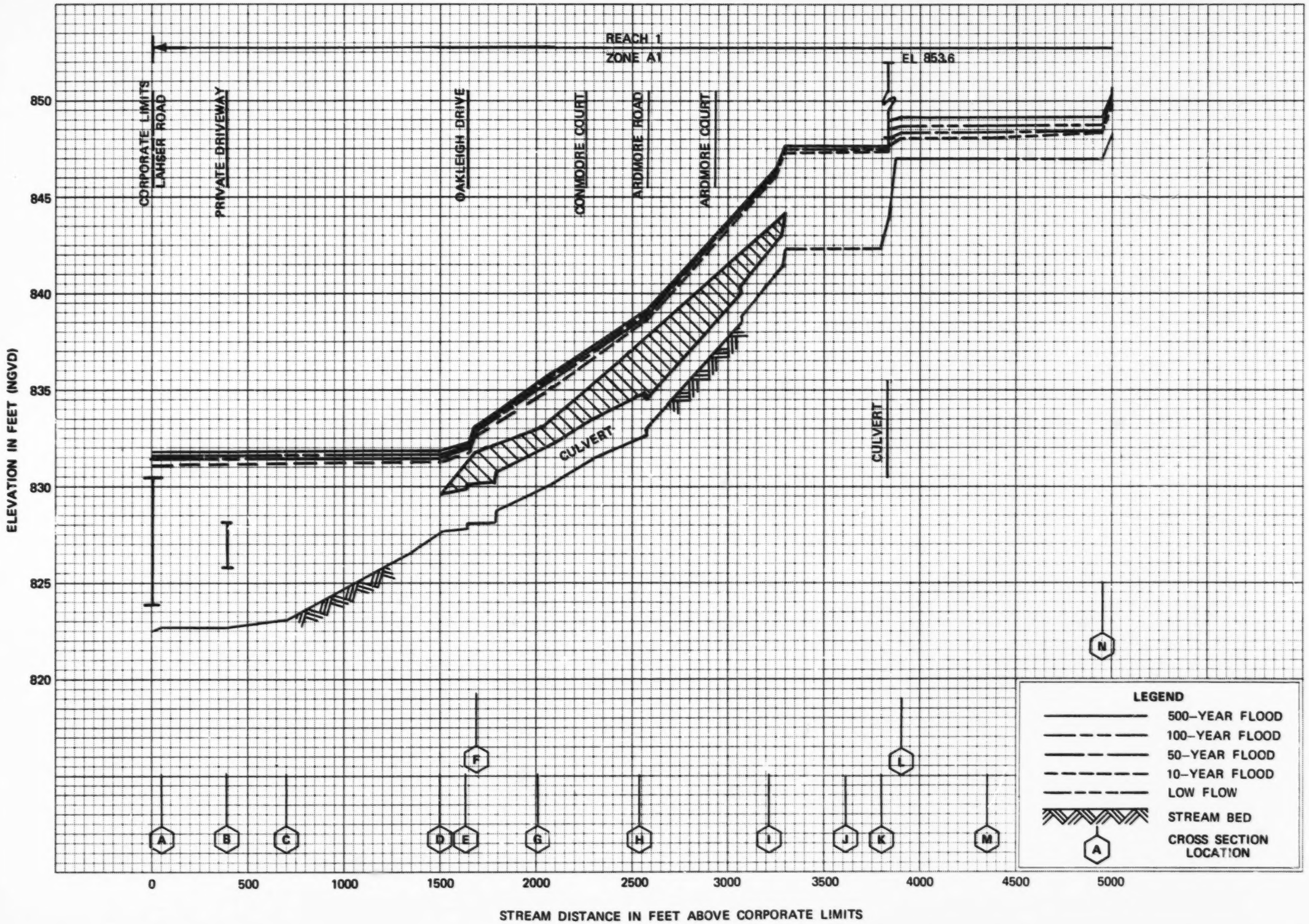


FLOOD PROFILES

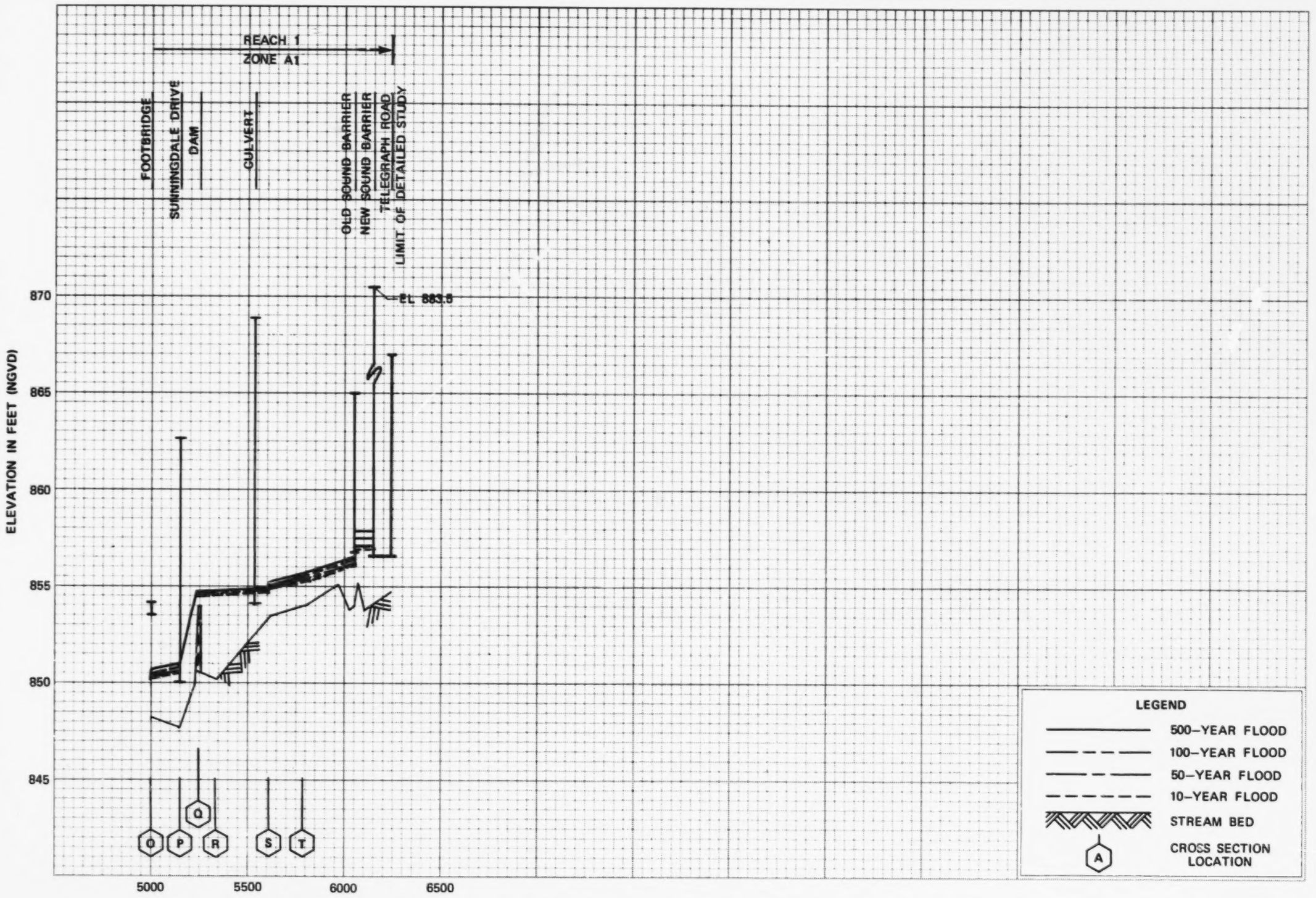
SODON LAKE DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

09P

BEST DOCUMENT AVAILABLE



FLOOD PROFILES

SODON LAKE DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

10P

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FLOOD PROFILES

LONG LAKE-FOREST LAKE DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI
(OAKLAND CO.)

11P

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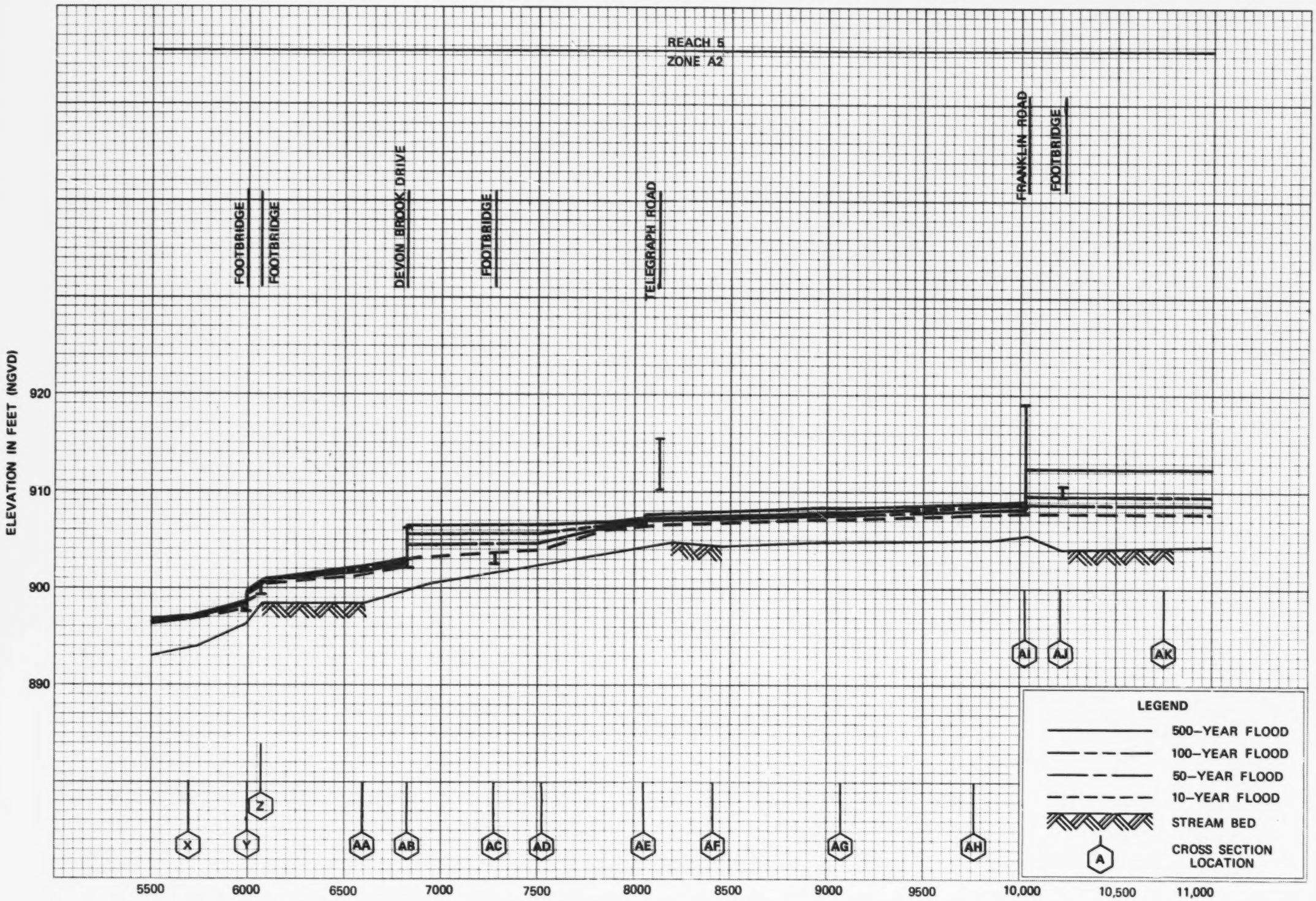

FLOOD PROFILES

LONG LAKE-FOREST LAKE DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BLOOMFIELD, MI

(OAKLAND CO.)

12P

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FLOOD PROFILES

LONG LAKE-FOREST LAKE DRAIN

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